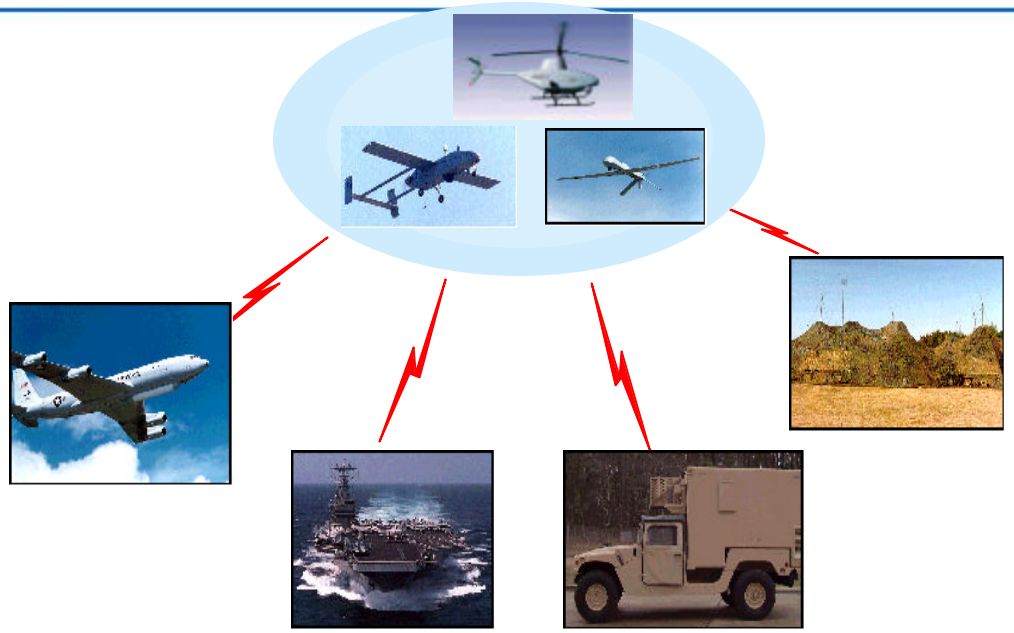
Tactical Control System Command & Control for Unmanned Systems

Ms. Amy Houle Caruso
PMA 263-2

Tactical Control System

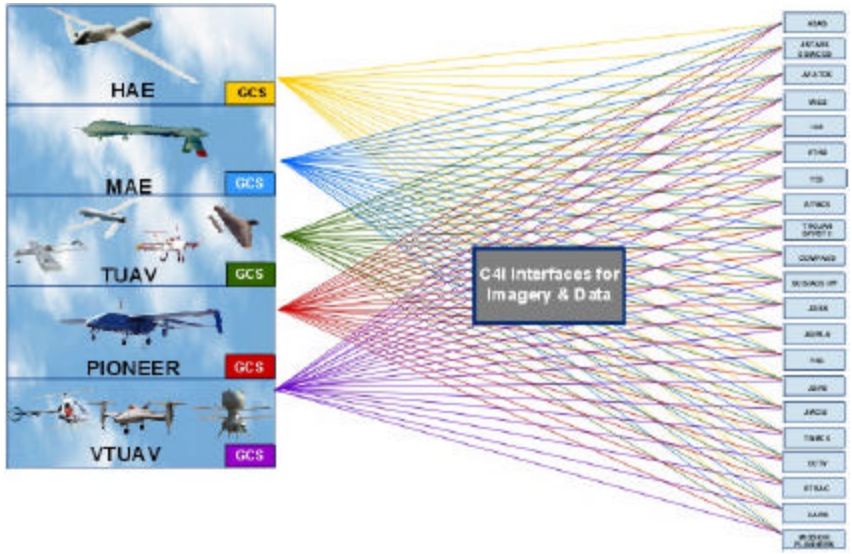


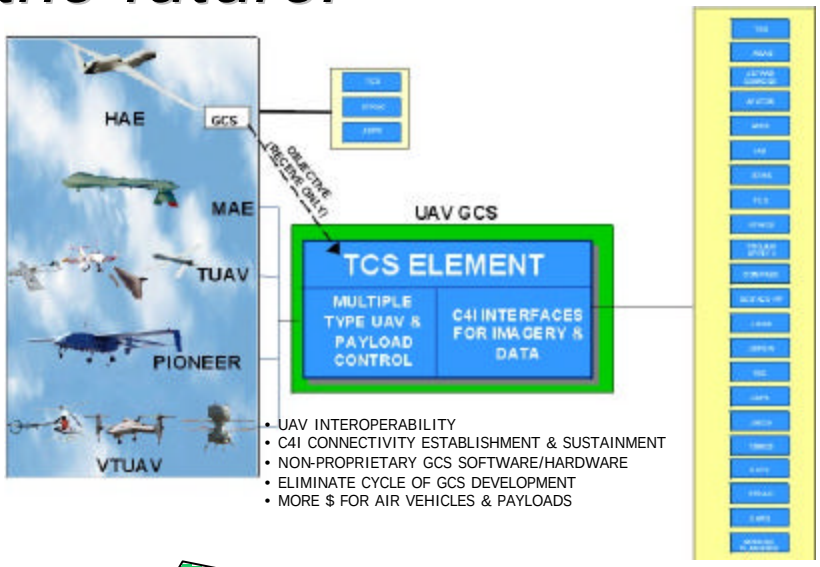
- Open Systems - Reduced Cost of Development & Integration
- UAV Command and Control Interoperability
- UAV / C4I Systems Interoperability
- Sensor and Payload Control
- Rapid Target/Imagery Dissemination
- Common Human Computer Interface - Reduced Training
- Non-Proprietary GCS Software/Hardware – Reduces Cost / Risk
- More Dollars For Operations, Air Vehicles & Payloads

TCS Vision

TCS is the ground segment for all Naval unmanned vehicles and multi-service UAVs and supports the transformation of UAV operations into Network Centric Warfare and the future.

FROM THIS PARADIGM...





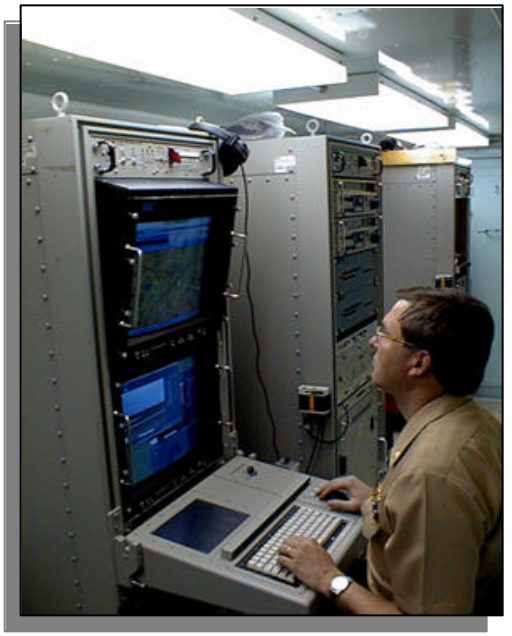
TO THIS PARADIGM...

Agenda

- Naval Activities
- Requirements
- Architecture
- Interfaces
- TCS Program
- Conclusions

Tactical Control System (Navy Perspective)

- **Joint program, Navy lead**
  - Provides C2 for joint family of UAVs
  - Provides direct receipt of data from UAVs
  - Provides for connectivity to major Service C4I systems
- **Naval Requirement**
  - TCS for multiple and Joint UAV / sensor access
  - Need for mobile, light and multi-use equipment
- **Naval Road Ahead**
  - Integrate TCS Level II - IV into Global Hawk, Predator, BAMS, TUAV and Pioneer and onto big decks and command ships (FY05)

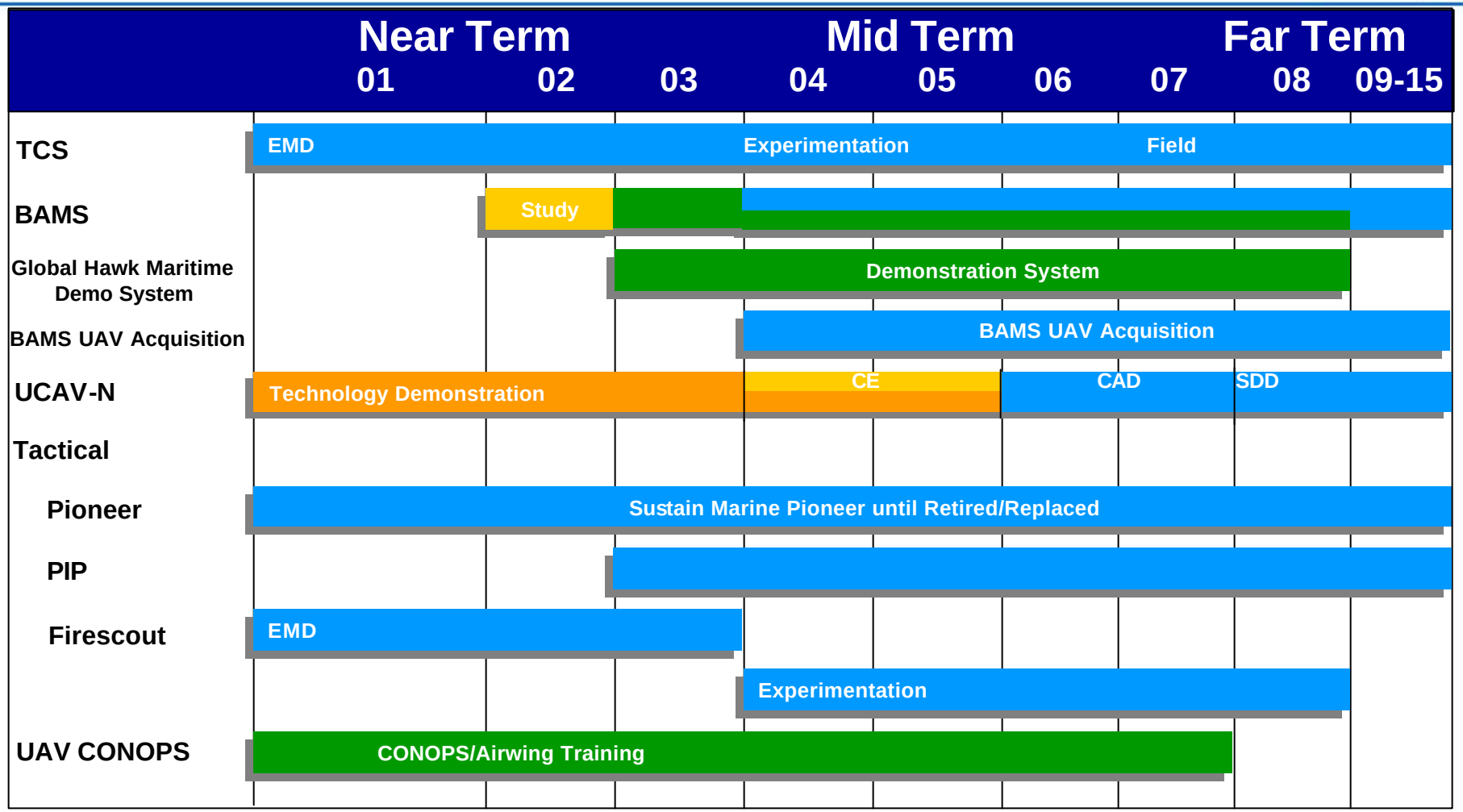


Potential for use in UGVs, UUVs and USVs

TCS levels of control:

LEVEL I	LEVEL II	LEVEL III	LEVEL IV	LEVEL V
• Indirect Product	• Direct Data Receipt	• Payload Control • Direct Data Receipt	• Flight Control • Payload Control • Direct Data Receipt	• Launch & Recovery • Flight Control • Payload Control • Direct Data Receipt

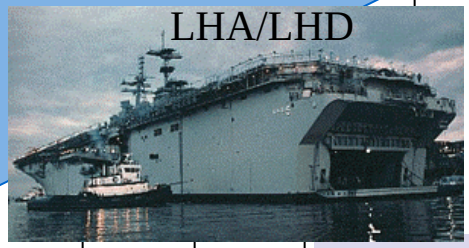
Naval UAV Activities



Proposed Tactical Control Systems Installations

GHDS
Land based
Ship based

Firescout
S-280 Shelters
788 Shelters



788 USMC
Shelters

P3 Demo

MMA

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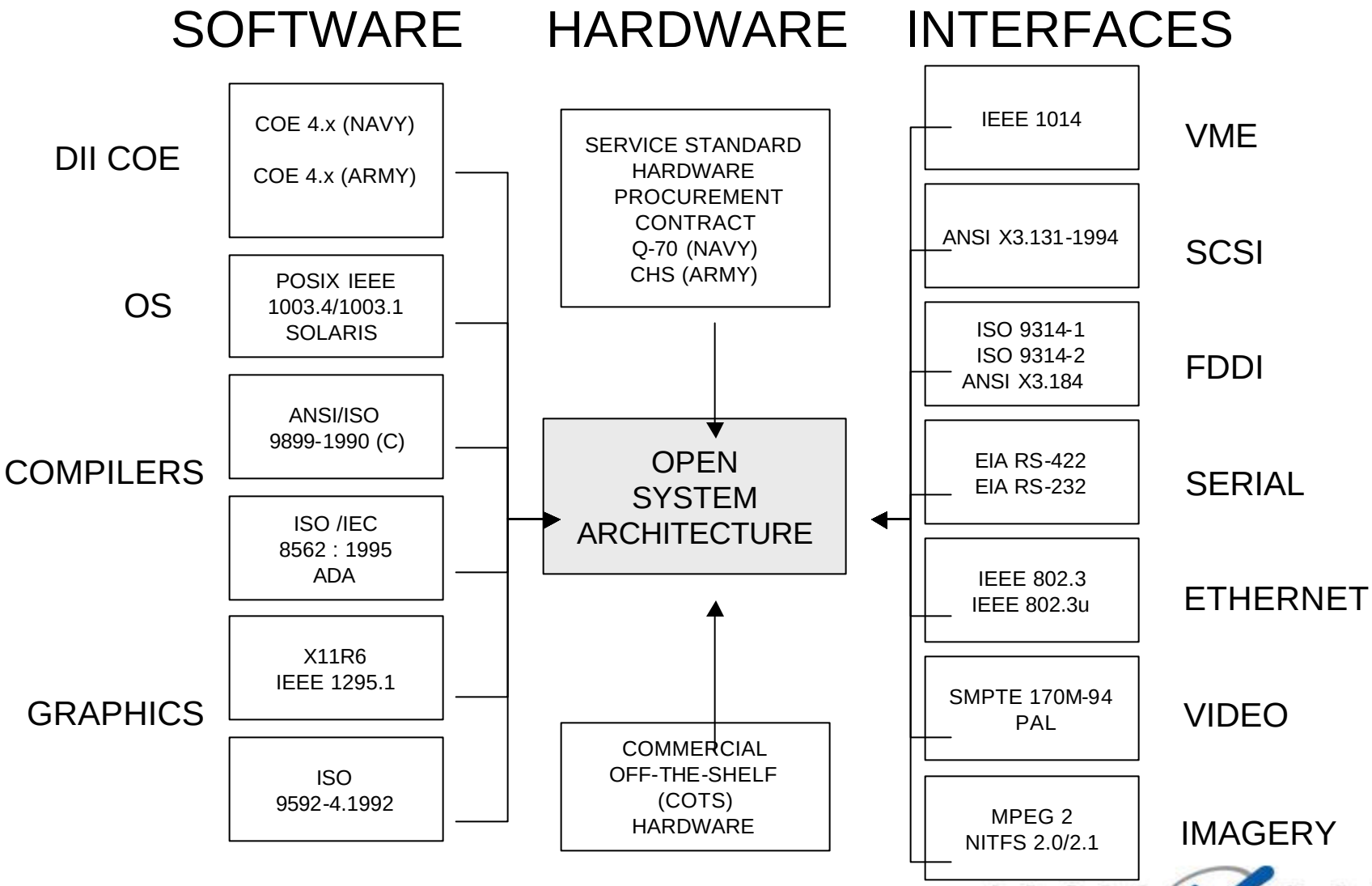
Key Technical Architecture Requirements

DERIVED FROM TCS ORD (FEB 00)

- Open System (HW & SW) Architecture
- JTA Compliant
- DII COE Compliant
- United States Imagery and Geospatial System (USIGS) Compliant,
- Video Imagery Standards Profile (VISP) Compliant
- UAV & Payload Interaction
- C4I System Interoperability
- GCCS Compliant
- CIGSS/DCGS Compliant

Key Technical Architecture Requirements



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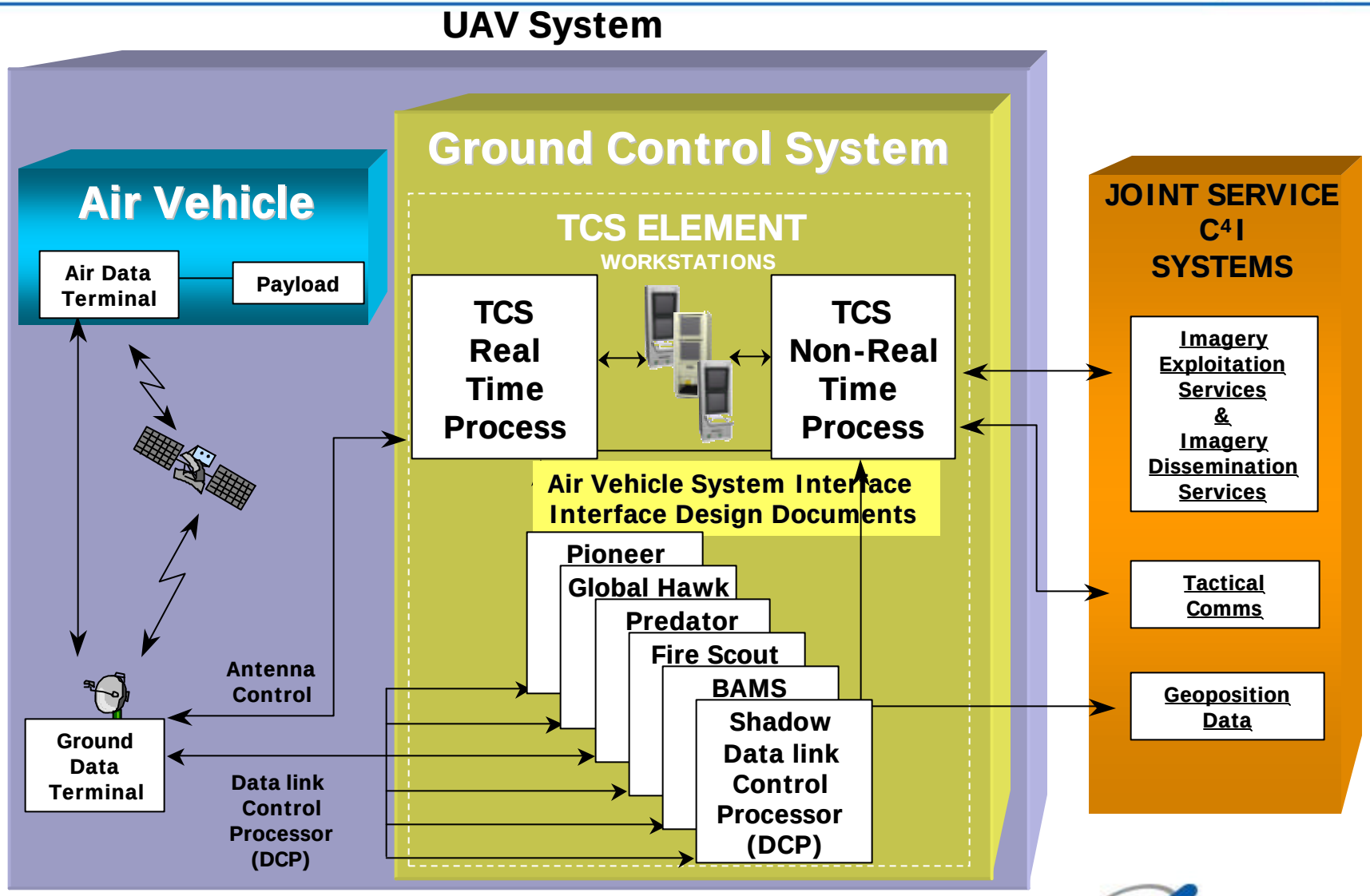
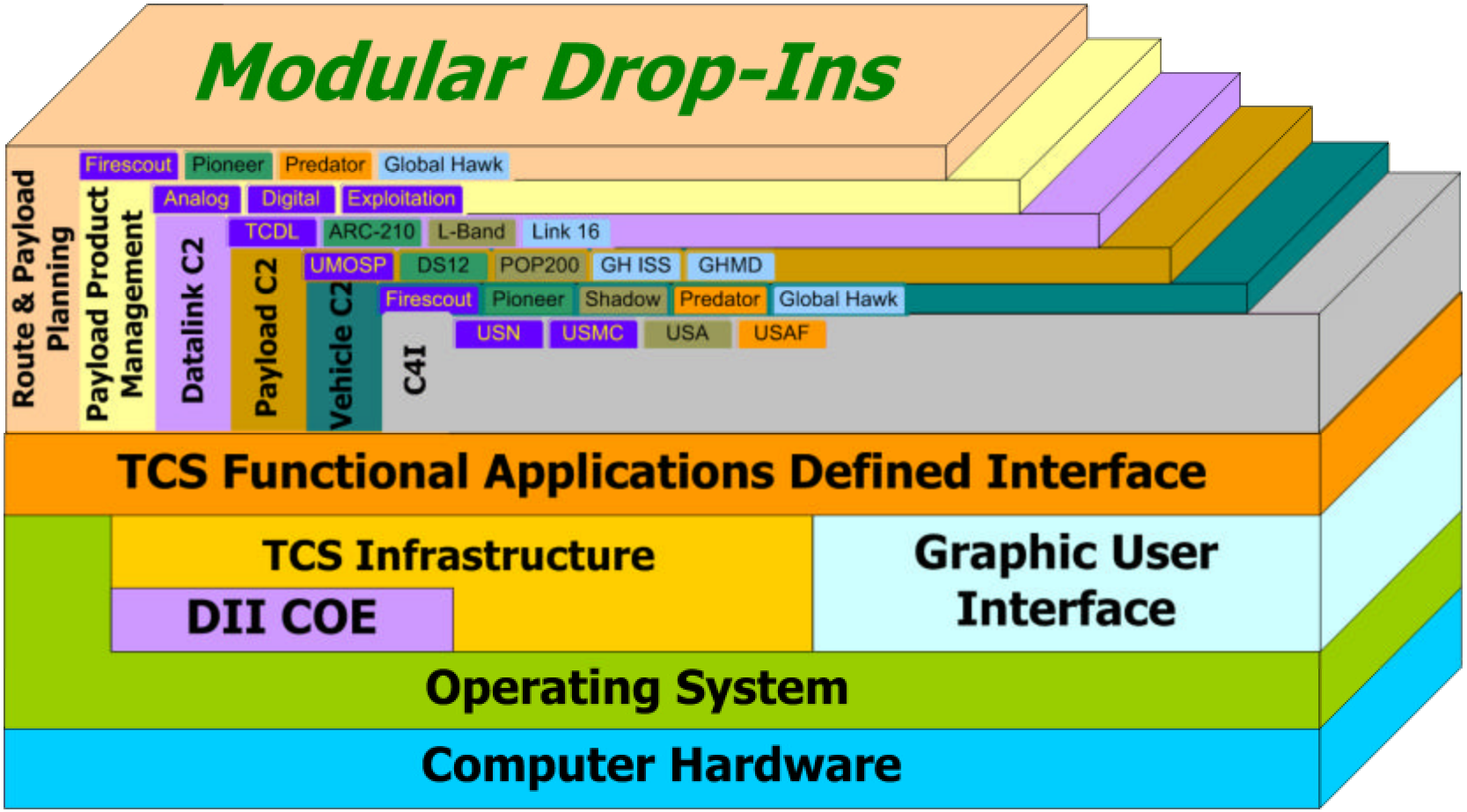
TCS Functional Architecture

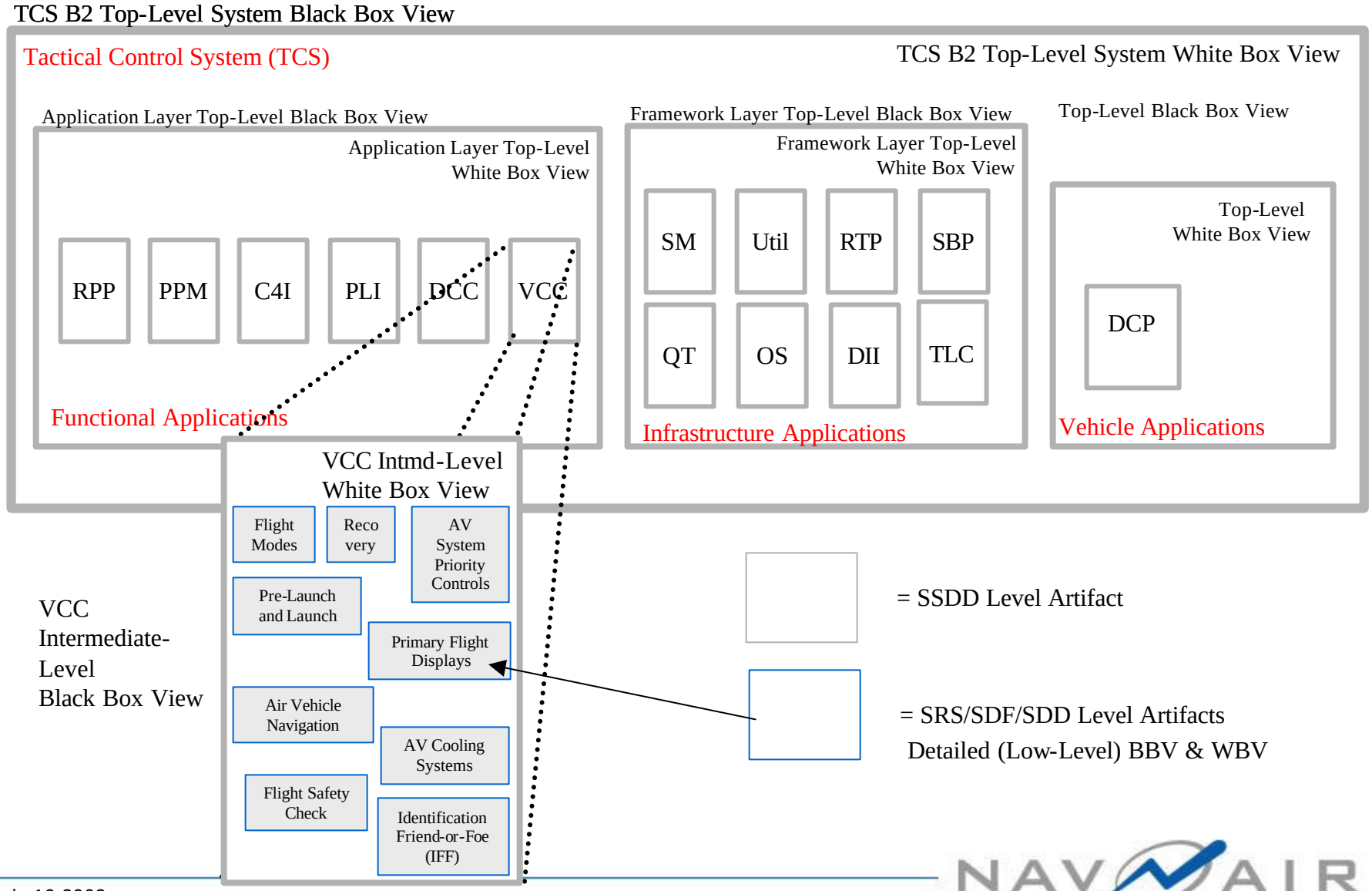


TCS Software Architecture

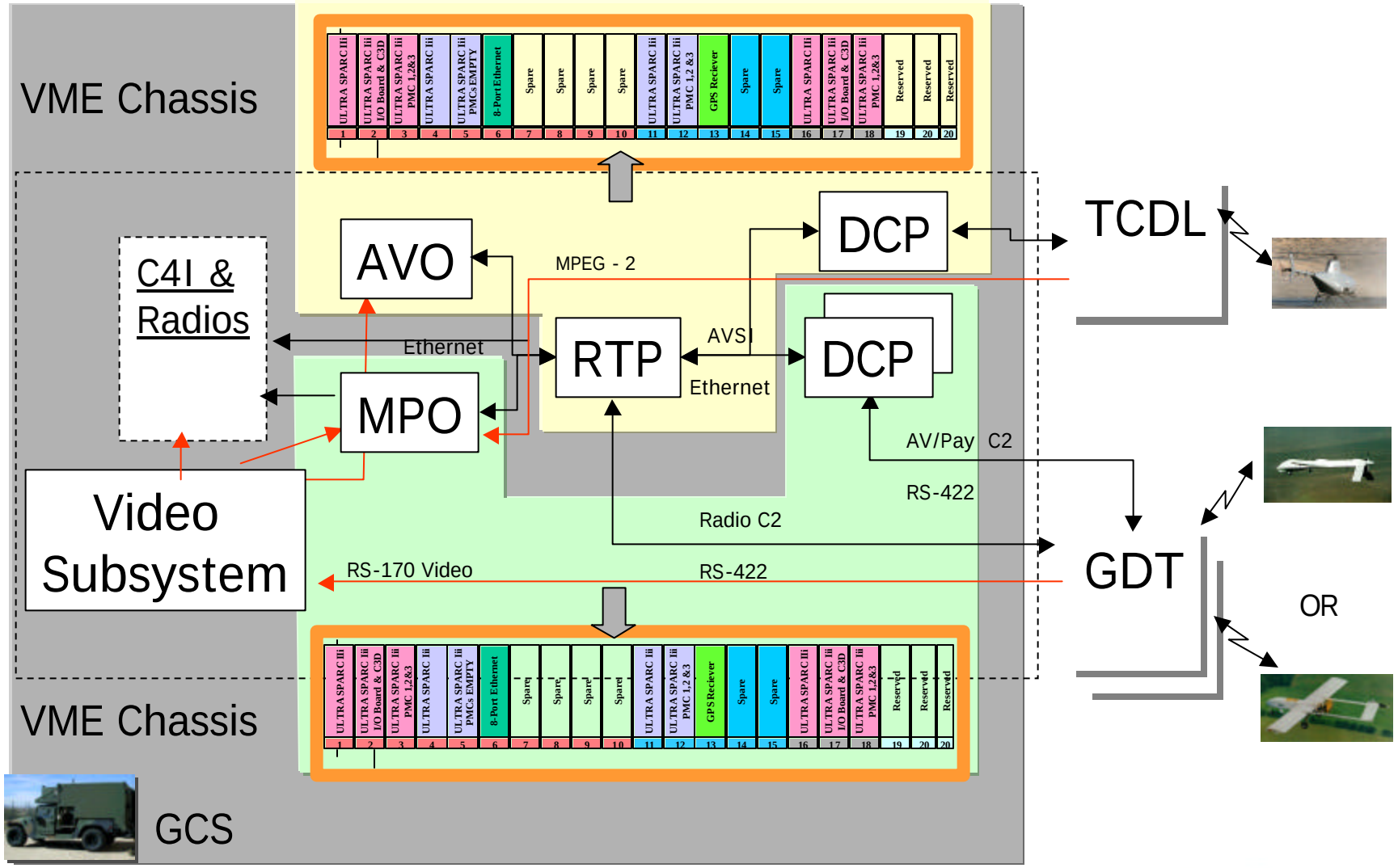


Multiple Operating Systems; Mix & Match Payloads, Platforms, and C4I Interfaces

Artifacts of the Design
CSCI Laydown



TCS Hardware Architecture



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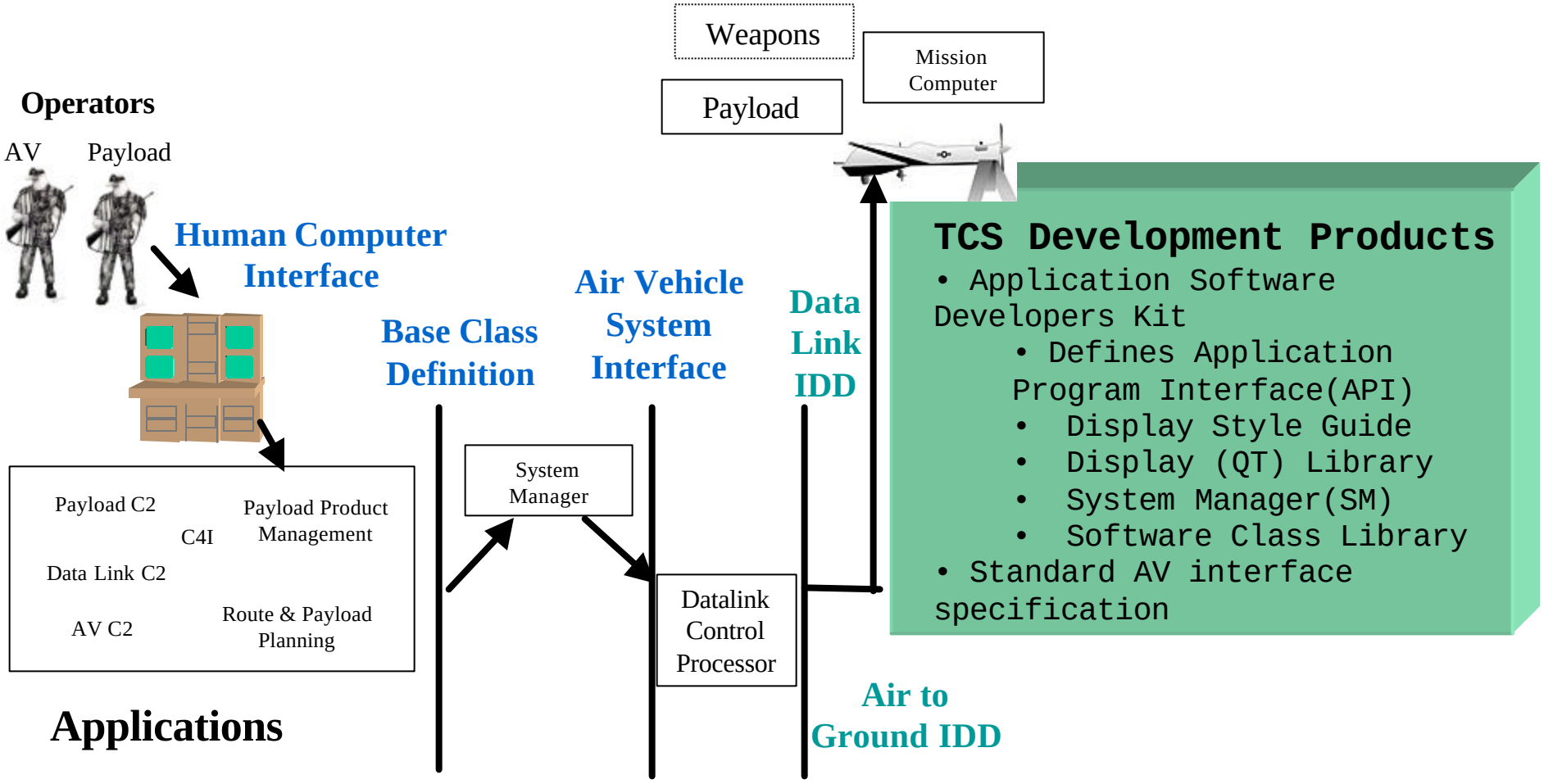
Operator to A/V Chain



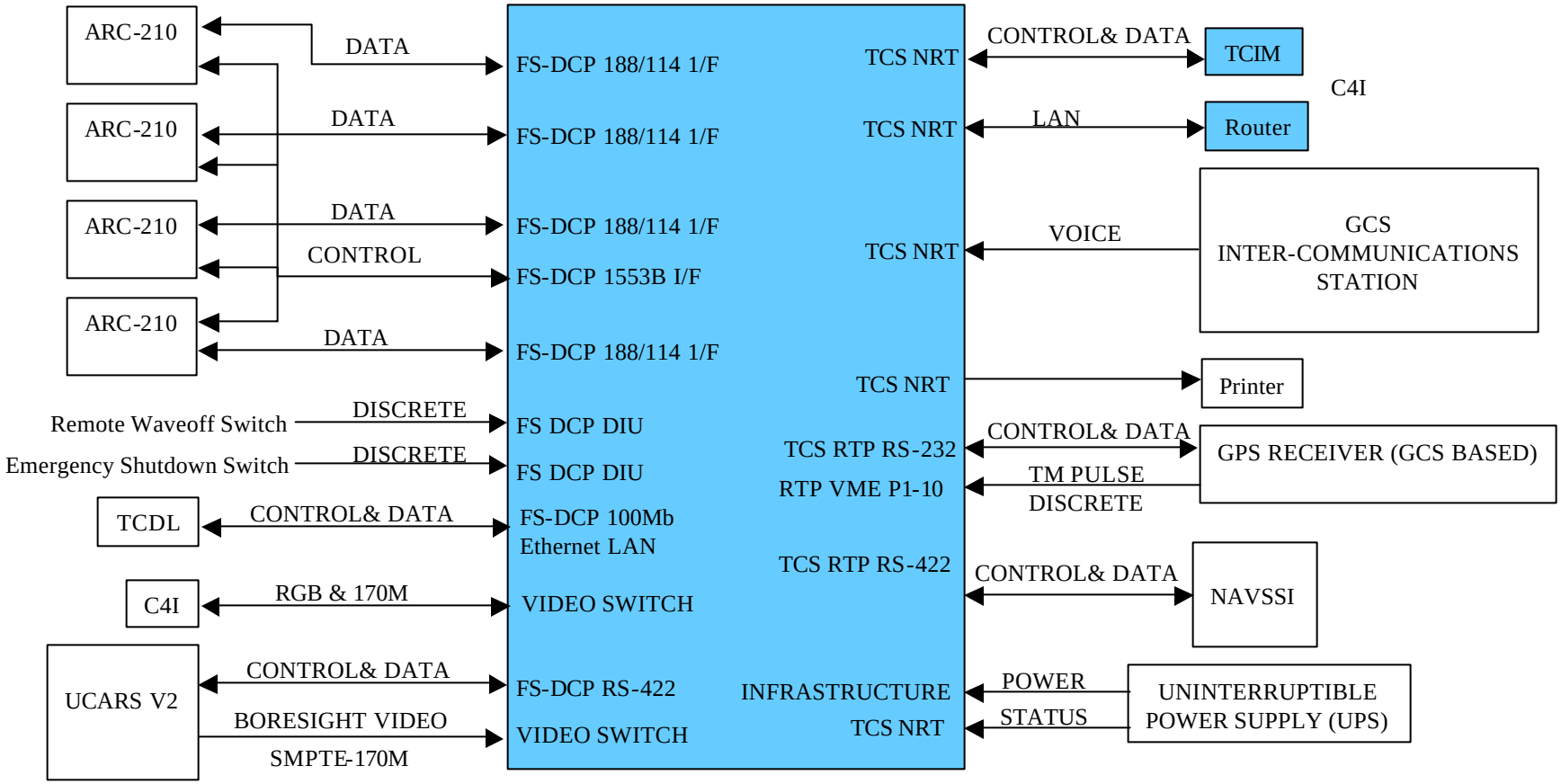
TCS Development Products

- Application Software Developers Kit
  - Defines Application Program Interface(API)
  - Display Style Guide
  - Display (QT) Library
  - System Manager(SM)
  - Software Class Library
- Standard AV interface specification

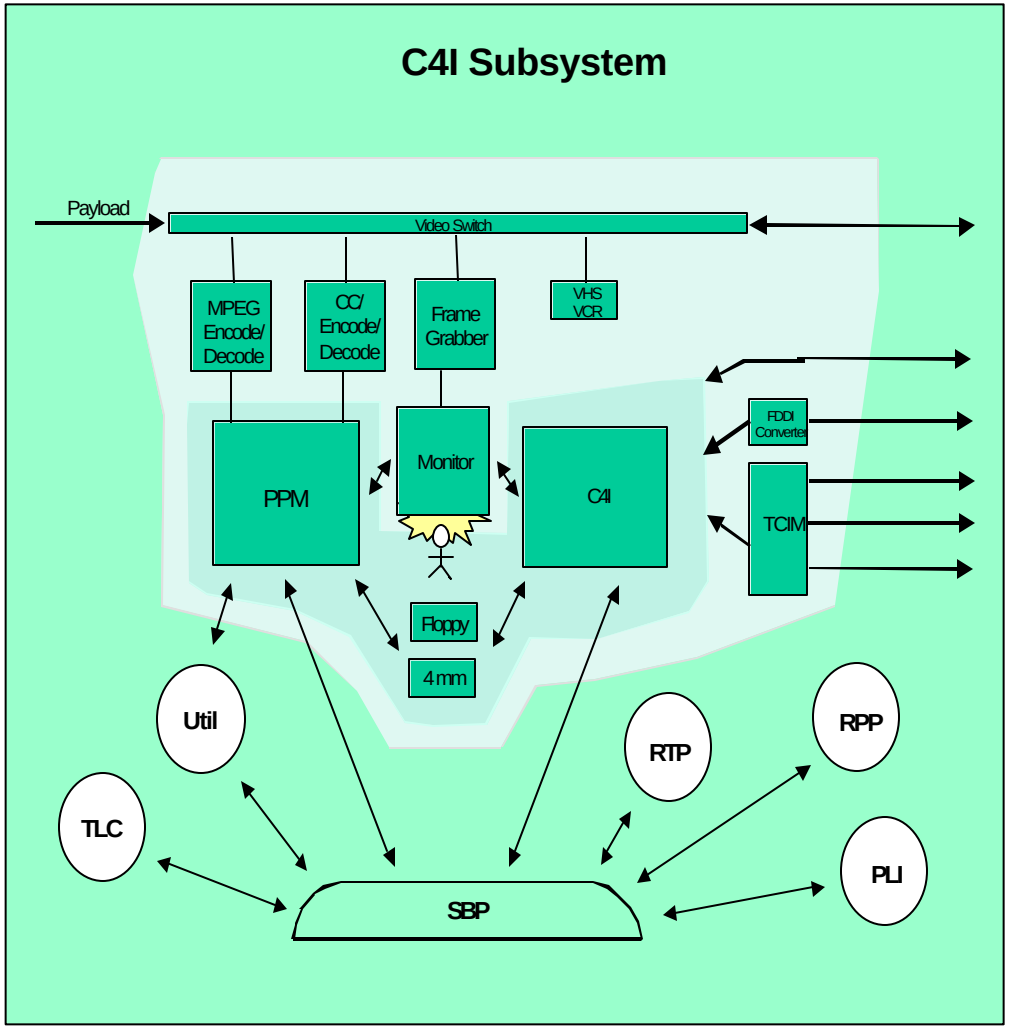
Air Vehicle System Interface Based on open standards; Mature in development; Provides a flexible and distributed capability for AV, Sensor and growth to include Weapons control

TCS External Interfaces

TCS Element



C⁴I Subsystem External Interfaces



SMPTE 170M — Analog Video

Ethernet — Tactical Messages, E-mail, Imagery (NITF), Digital Video

FDDI

TCIM SINCGARS

TCIM MSE — Tactical Messages

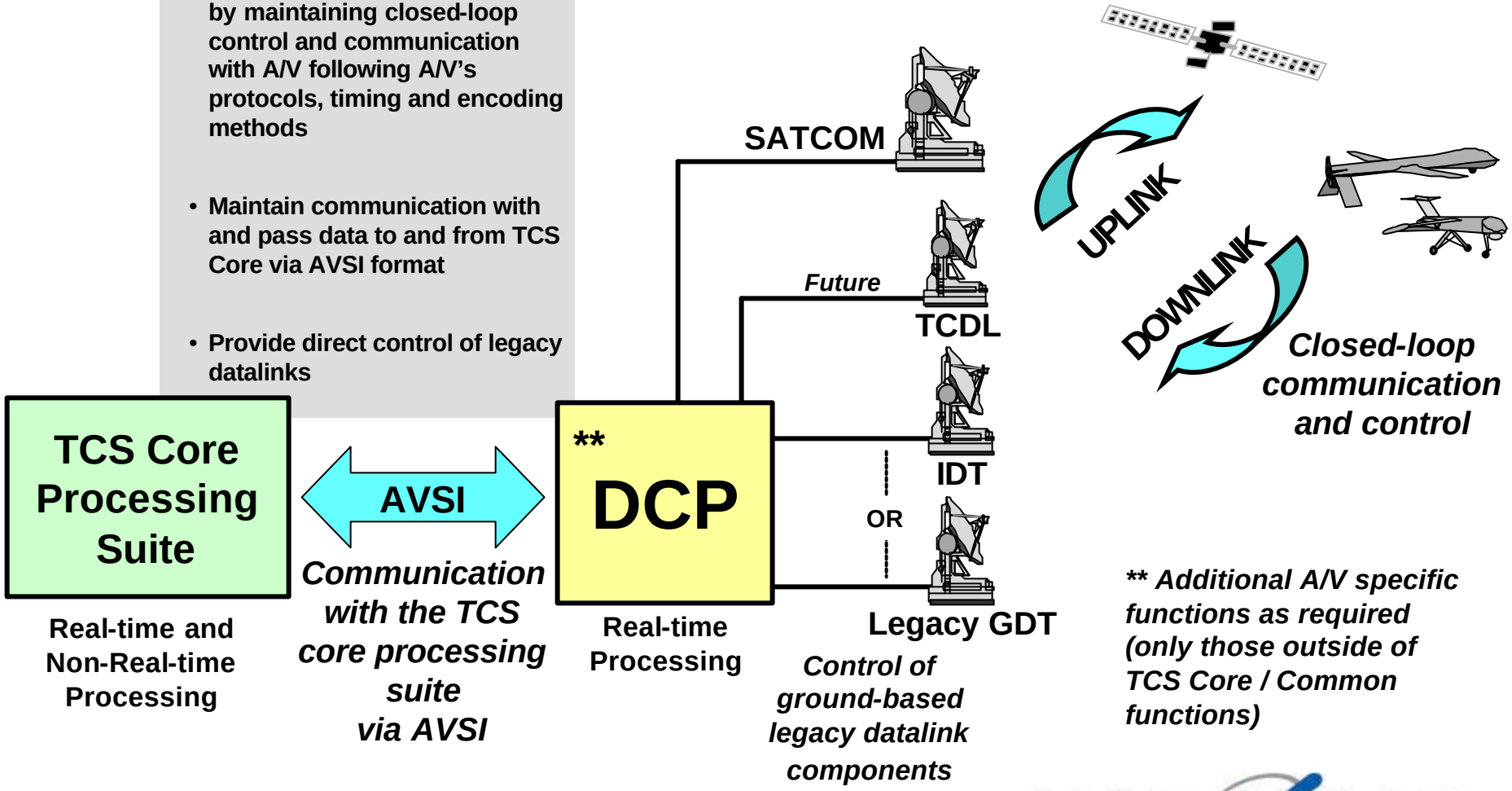
TCIM EPLRS

EXTERNAL C4I SYSTEMS

What is a Datalink Control Processor?

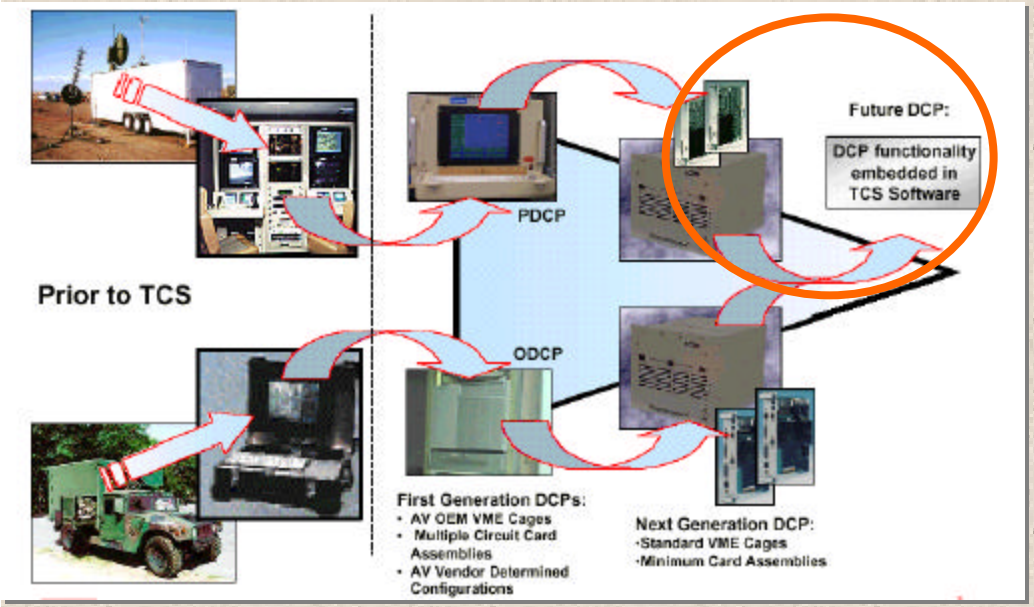
DCPs :

- **Insulate TCS Core from A/V specific interface peculiarities by maintaining closed-loop control and communication with A/V following A/V's protocols, timing and encoding methods**
- **Maintain communication with and pass data to and from TCS Core via AVSI format**
- **Provide direct control of legacy datalinks**



*** Additional A/V specific functions as required (only those outside of TCS Core / Common functions)*

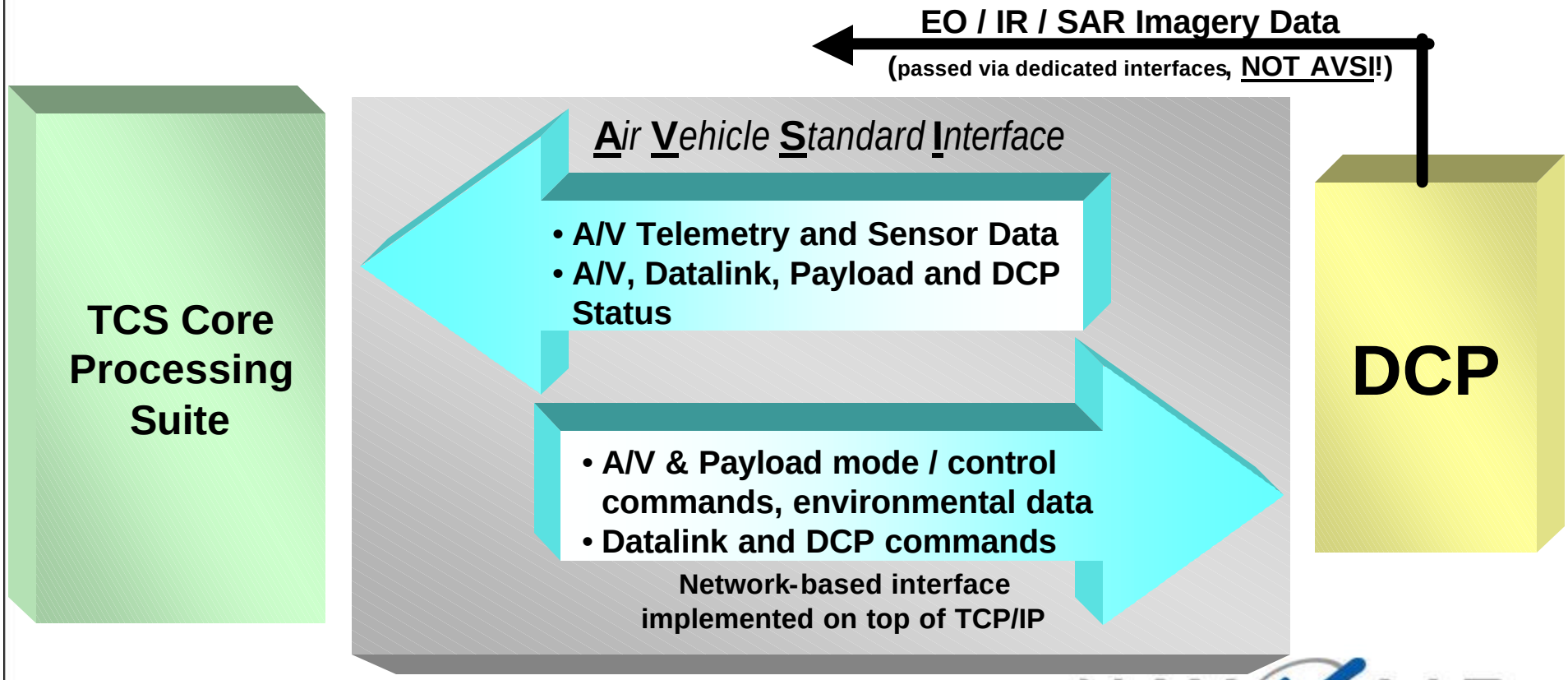
Software DCPs



- Continue to reduce physical footprint of vehicle interface to TCS - Datalink Control Processor (DCP)
- Eliminate Unique Hardware to facilitate insertion of TCS into new and existing systems
- Block 3 will progress to combination DCP alternatives
  - Re-Programmable Cards
  - Software Only

What is the Air Vehicle Standard Interface?

AVSI provides a common interface message standard for the TCS Core to communicate with A/Vs via the DCPS



WHAT IS THE AIR VEHICLE STANDARD INTERFACE?

EOIR Command Message								
tion	Field Id	Data Element Name & Description	Type	Units	Range	Comments	DCP	AV Specific Range
0	AVSI0602	**EOIR_Payload_Pointing_Mode** Controls the pointing mode of the payload.	Integer 4	None	0 <= x <= 10	0 = Point at position given be EO/IR Pointer Latitude, EO/IR Pointer Longitude 1 = Point at EO/IR Azimuth, EO/IR Depression 2 = Auto track 3 = EOIR in waypoint control. This value is only allowed when the AV is currently in waypoint mode 4 = Rate Mode, EO/IR pointing position modified by EOIR_Azimuth_Rate and EOIR_Depression_Rate 5 = Locked at pilot's window position 6 = Stow 7 = Vertical Mode 8 = Auto Scan 9 = Auto Scan Configure 10 = Pilot Window Configure	Predator	x = 0,3,4,5,7 For Predator, while in pointing mode 5, the payload position may be modified by the EOIR_Azimuth and EOIR Depression commands
							Pioneer	x = 0,1,4,5,6
							Shadow	x = 0,1, 4,5,6,8,9,10
							Firescout	
1	AVSI1704	**EOIR_Autotrack_Mode** Commands the EOIR payload to switch between autotrack modes of off, acquire, and track. The payload switches mode on a transition of this field from 0 to 1	Integer 4	None	0 <= x <= 1	0 = No change 1 = Switch modes.	Predator	Not Supported
							Pioneer	Standard Payload must be in pointing mode 0 or 4 for this field to be used.
							Shadow	Standard
							Firescout	
2	AVSI0604	**EOIR_Pointer_Latitude** Commands the latitude of the EO/IR pointing position.	Double 8	Degrees	-90 <= x <= 90	Positive value indicates North latitude. This field is only valid when EOIR_Payload_Pointing_Mode = 0 or 3.	Predator	Standard
							Pioneer	Standard
							Shadow	Standard
							Firescout	
3	AVSI0605	**EOIR_Pointer_Longitude** Commands the longitude of the EO/IR pointing position.	Double 8	Degrees	-180 < x <= 180	Positive value indicates East longitude. This field is only valid when EOIR_Payload_Pointing_Mode = 0 or 3.	Predator	Standard
							Pioneer	Standard
							Shadow	Standard
							Firescout	
4	AVSI0606	**EOIR_Pointer_Altitude** Commands the altitude above MSL of the EO/IR pointing position.	Double 8	Feet	-2000 <= x <= 100000	Referenced to WGS 84. This field is only valid when EOIR_Payload_Pointing_Mode = 0 or 3.	Predator	-2000<= x <= 32767
							Pioneer	Standard
							Shadow	Standard
							Firescout	
5	AVSI0607	**EOIR_Depression** Controls the EO/IR pointing depression.	Double 8	Degrees	-90 <= x <=120	Positive value indicates down. Depression is given in reference to the Air Vehicle. This field is only valid when EOIR_Payload_Pointing_Mode = 1.	Predator	-8 <= x <= 8
							Pioneer	-90 <= x <= 90

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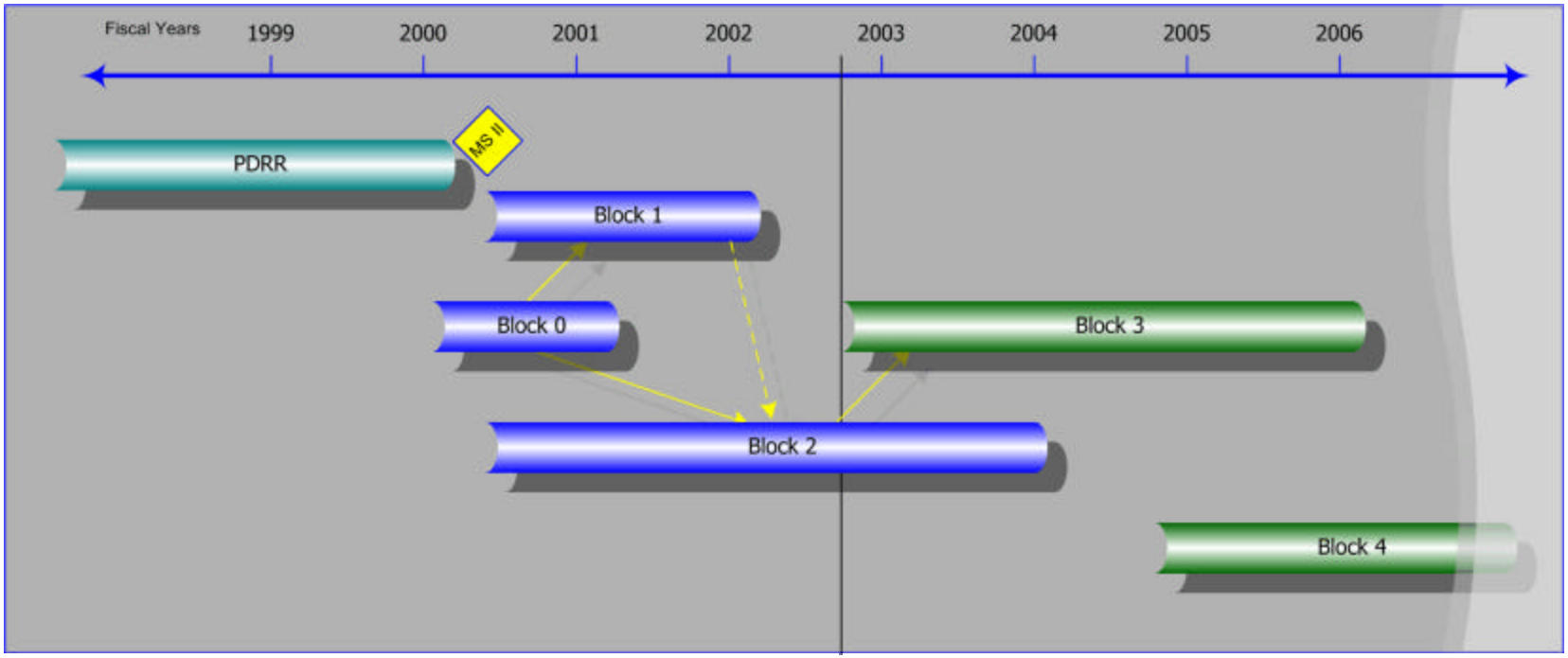
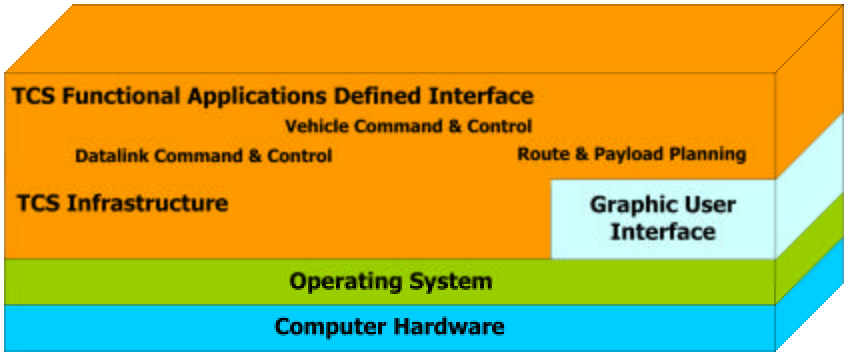
TCS Program Schedule



Block 1 - TUAV Shadow Functionality
Block 2 - Firescout functionality, critical capability development for future users
Block 3 - Combine Multi-Service UAV functionality into one build; conduct Global Hawk CVN Integration

Block 0

Software Architecture



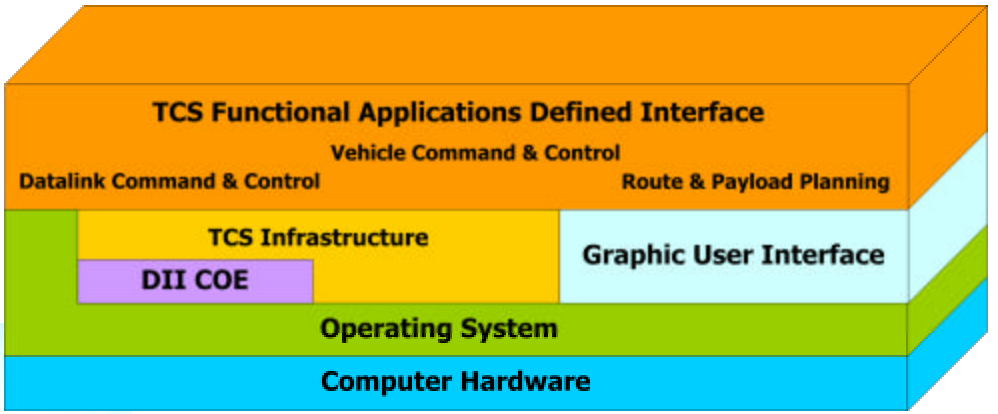
Block 0 Verified H/W Architecture

Highly Coupled

Difficult to Maintain

Block 1

Software Architecture



Modular

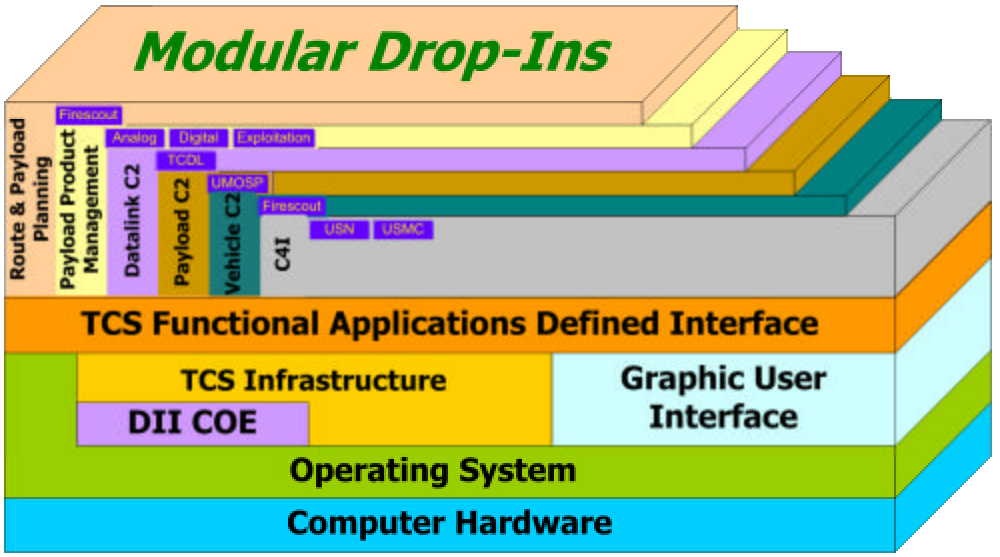
Separated OS from Applications / Infrastructure

Block 2

Open Architecture

JTA Compliant

Fully Modular

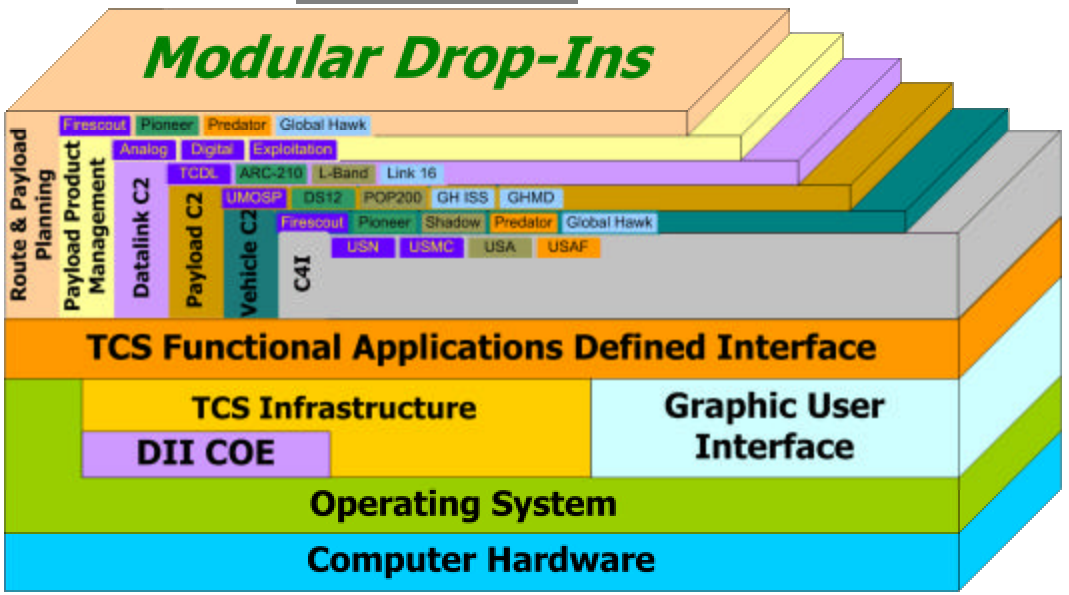


Block 3

Global Hawk Maritime Demonstration Program

New Applications "Plugged In"

Applications Isolated from Infrastructure and OS



Multiple Operating Systems; Mix & Match Payloads, Platforms, and C4I Interfaces

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Conclusions

- Significant effort and funding has been invested in the Joint Tactical Control System (TCS)
- With TCS, additional C4I systems and air vehicles can be included quickly and with low risk
- TCS Offers Many Advantages
  - Open Systems – Reduced Cost of Development & Integration
  - UAV/C4I Systems Interoperability
  - Common Human Computer Interface - Reduced Training
  - Non-Proprietary GCS Software/Hardware – Reduces Cost / Risk
  - More Dollars For Operations, Air Vehicles & Payloads
- TCS is an integral part of Naval Network Centric Warfare plans and operational concepts

Questions

RQ-2A Pioneer

RQ-8A Fire Scout

RQ-1B Predator

RQ-4A Global Hawk

Dragon Eye

RQ-5A Hunter

TCS

Naval UCAV USAF UCAV

X-45A UCAV was previewed in St. Louis last year.

RQ-7A Shadow 200

BACK-UPS

Agenda

- Naval Activities
- NATO STANAG 4586 Activities
- Requirements
- Architecture
- Interfaces
- TCS Program
- Conclusions

NATO Approach

- NATO industry/government team
- Working for UAV control system (UCS) architecture
- STANAG 4586 will be a NATO standard
- Allow individual national development for interoperable UAV systems
- NATO funded

NATO STANAG 4586

STANAG No. 4586
Draft Version 3.0

NORTH ATLANTIC TREATY ORGANIZATION (NATO)

MILITARY AGENCY FOR STANDARDIZATION (MAS)

STANDARDIZATION AGREEMENT (STANAG)

SUBJECT: Standard Interfaces of UAV Control System (UCS) for NATO UAV Interoperability

Promulgated on

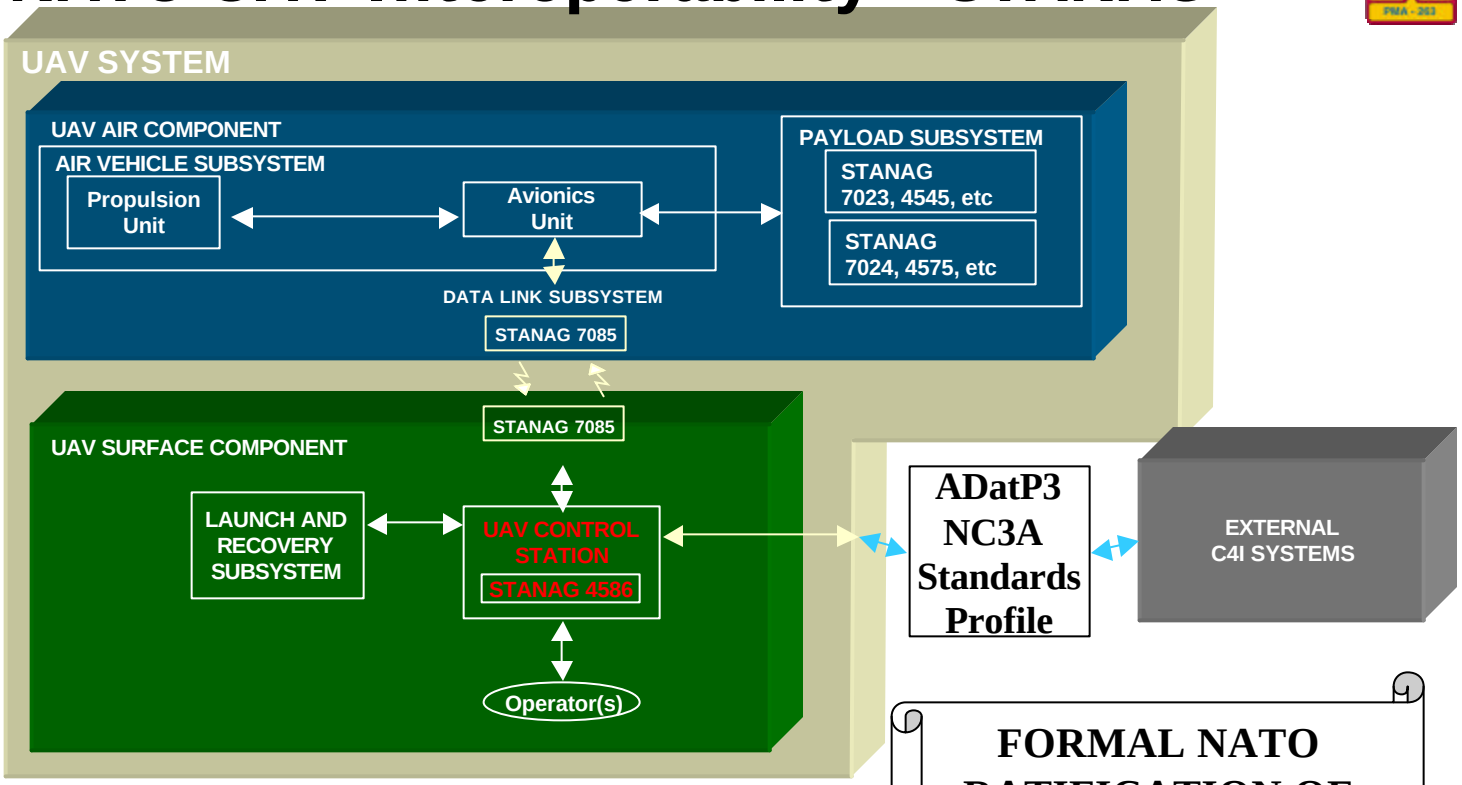
Chairman, MA

- NATO Standardization Agreement
  - Defines requirements for a Interoperable NATO UAV Control System (UCS)
  - Will provide UAV Interoperability among participating NATO nations

- TCS addresses STANAG 4586 compliance

International Effort – NATO UAV Interoperability STANAG

UAV SYSTEM INTEROPERABILITY STANAGS ARE DEPICTED IN WHITE (STANAG 4586 CURRENTLY IN RATIFICATION PROCESS)



STANAG 4586 NIAG Support Request OCT 99

FINAL STANAG 4586 DISTRIBUTED TO PG/35 NATIONS – OCT 01

NIAG UAV Auto. Ops. Pre-Feasibility Study- June 02

FORMAL NATO RATIFICATION OF STANAG 4586

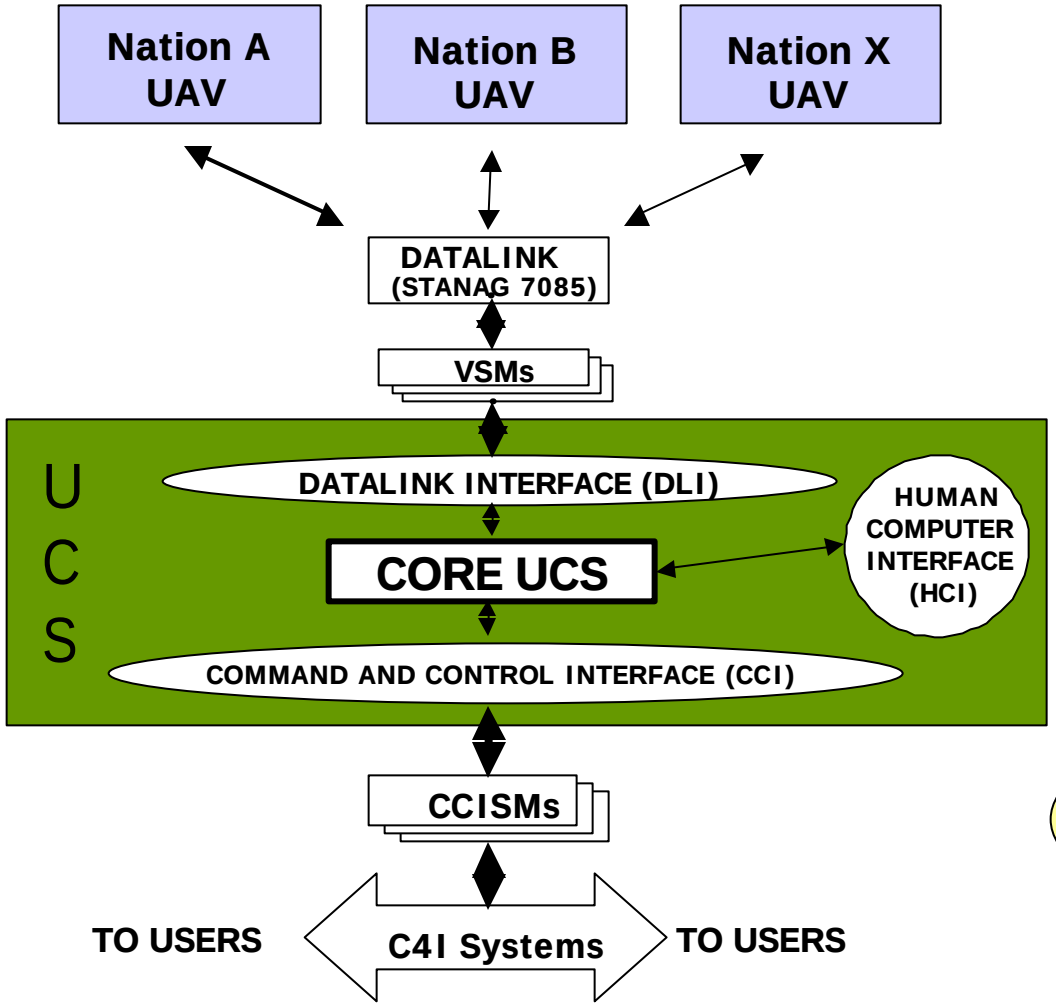
EST. OCT 03

DRAFT STANAG 4586 - MAR 01

STANAG 4586 IMPLEMENTATION & VALIDATION NIAG Support Request OCT 01

STANAG 4586 FINAL IMPLEMENTATION & VALIDATION DOCUMENT - OCT 03

NATO STANAG 4586
UCS Architecture



The TCS program has:

- Participated in the development of STANAG 4586
- Leveraged multinational technical exchanges
- Implemented an architecture that is consistent with the STANAG requirement
- Implemented interfaces that are similar to the STANAG defined DLI, CCI & HCI

TCS IS POISED TO BECOME STANAG COMPLIANT AND PROVIDE NATO INTEROPERABILITY!

STANAG Adherance

STANAG 4586
National Applications

CANADA

3 TCS

–MAE
–JOINT TACTICAL

UNITED KINGDOM

3 TCS

–WATCHKEEPER
–NAVY UAV

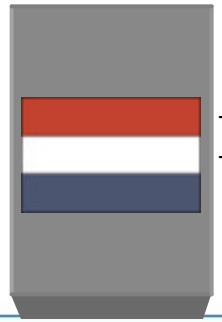
UNITED STATES

4 TCS (EDU)

Additional TCS

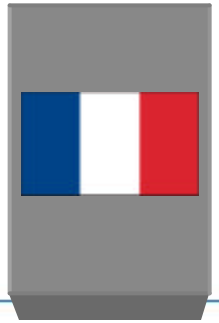
–AF PREDATOR
–ARMY SHADOW
–NAVY VTUAV

NETHERLANDS



–NAVY UAV
–Army UAV

FRANCE

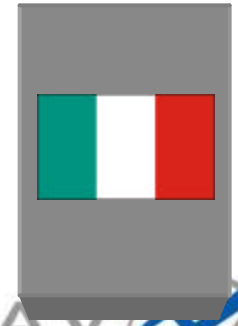


–LEVEL 2 NATO
–LEVEL 4 4586 OTHERS

GERMANY

–MBCS
–KZO
–CL289
–SEAMOS
–LUNA

ITALY



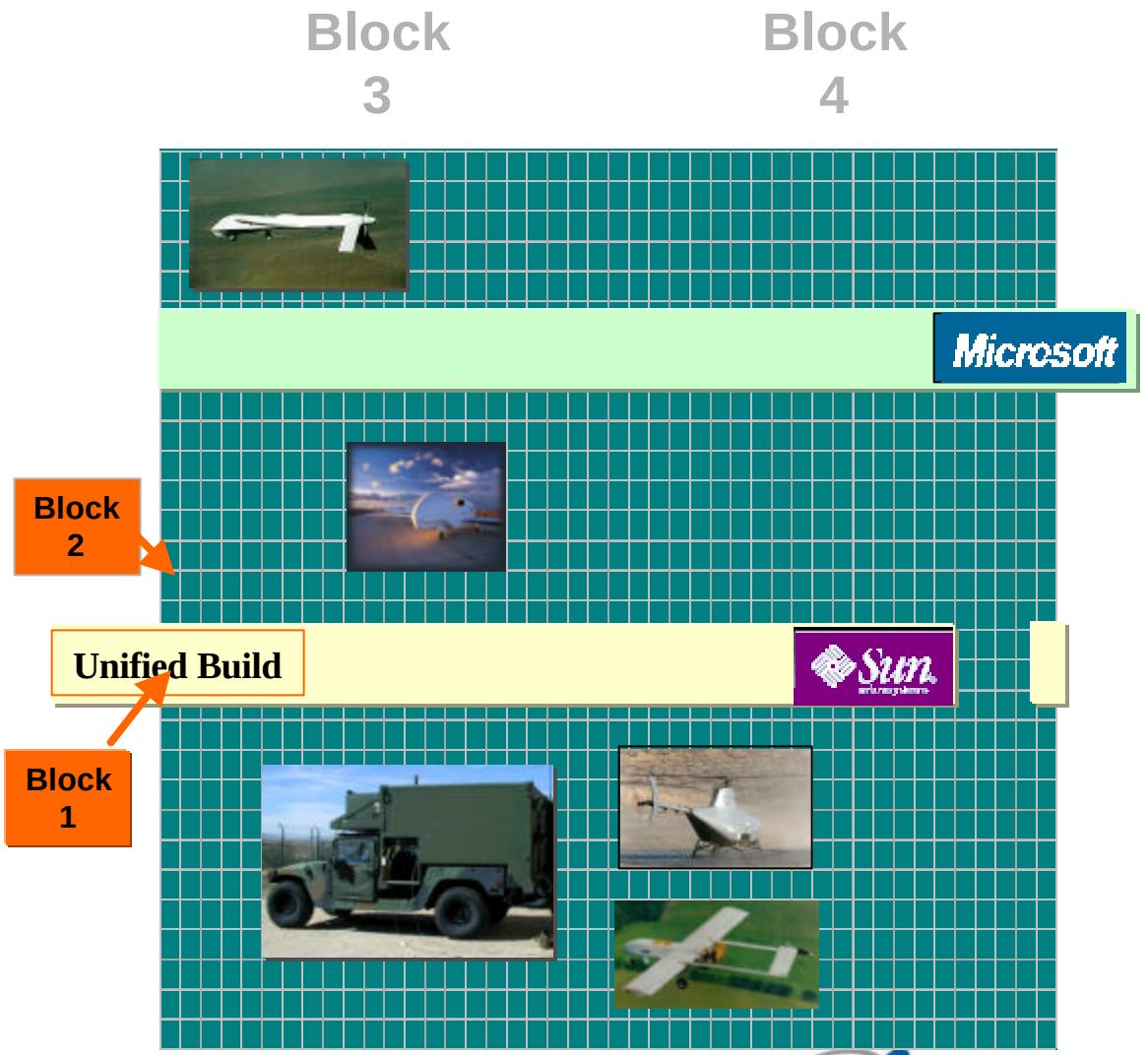
–MAE
–NAVY VTUAV

TCS Block Developments

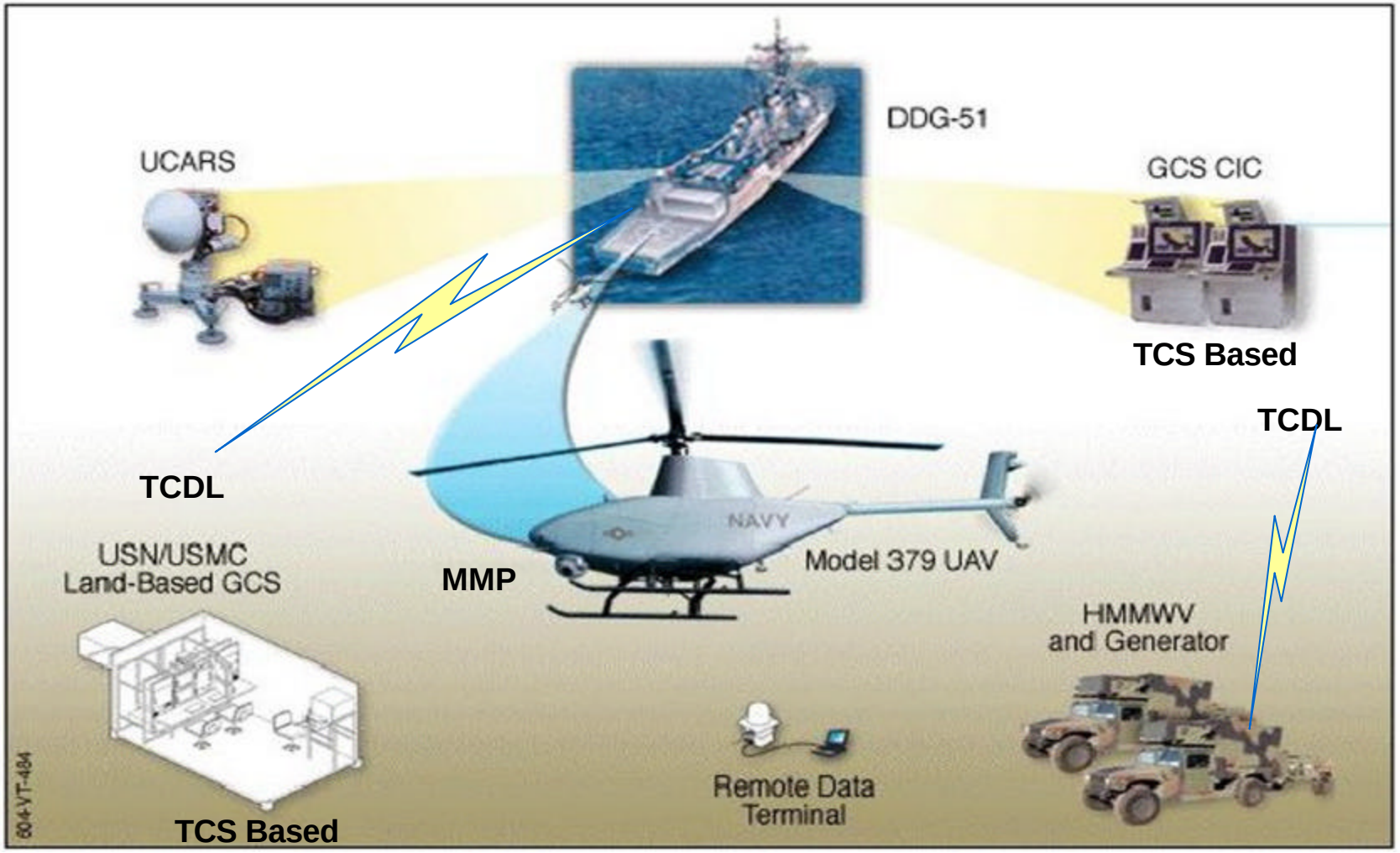
2 Threads

Windows Based
- PC Processor
- Windows XP
- DII COE Compliant
- Portable Systems
- Systems Evolving to Windows
- Long Term Product

Unix Based
- Sparc Processor
- Solaris
- Existing Systems

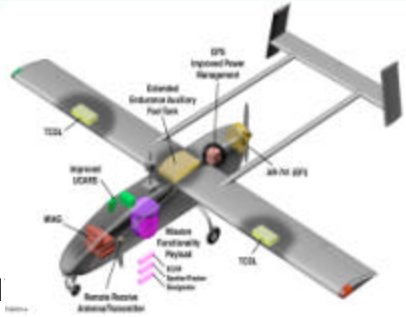


Firescout Demonstration System



Pioneer Improvement Program (PIP)

USMC Tactical UAV TCS HMM

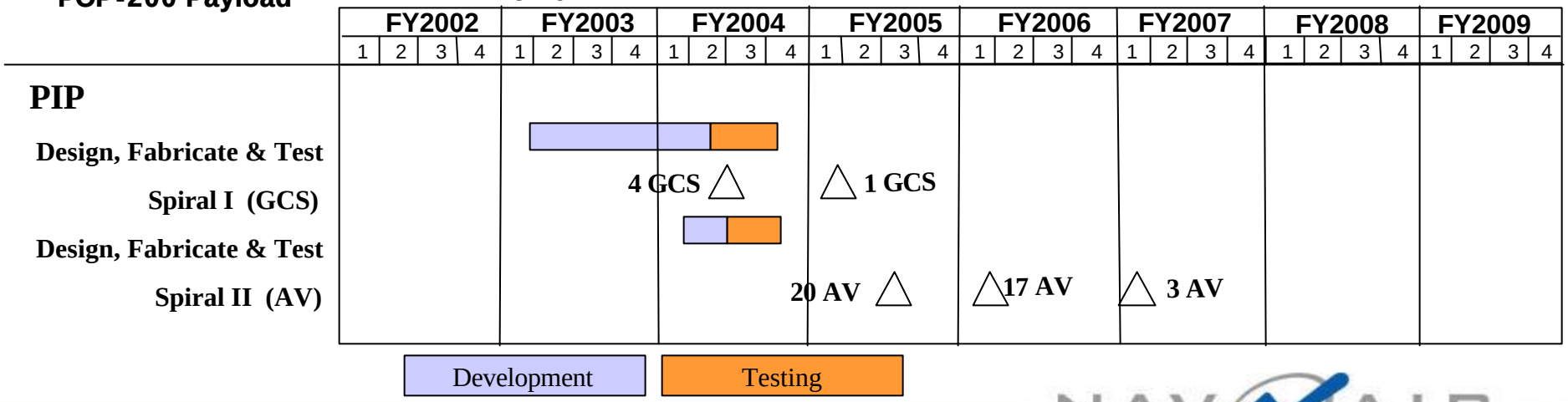


Upgraded Pioneer Air Vehicle

POP-200 Payload

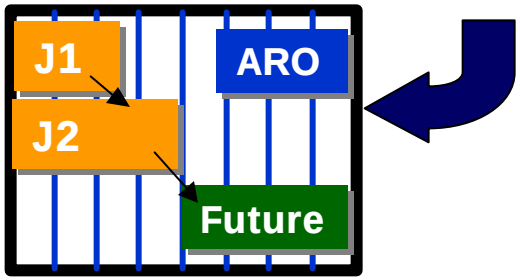
Folding Hydraulic Launcher

- Interoperable with Navy, Marine Corp and Army C4I Systems
- Logistically supportable
- USMC C130 Deployable
- Digital Video
- Ship-board Compatible
- Simulator/Trainer
- TCDL compliant
- L-Band Receipt
- Multiple UAV Control

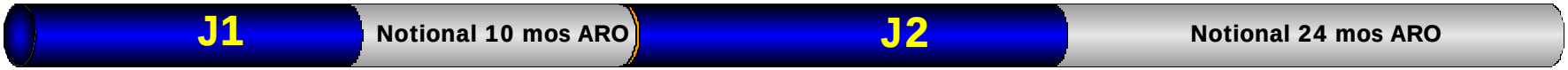


US Joint Forces Command
JOTBS Overview

- Minimum of 2 deliveries J1-J2



- Approach Aligned with current TCS plans
- TCS GCS Includes Two Operators (AVO/MPO) and a Mission Commander



Pioneer PIP Function Upgrade

(Block 0)

Predator Function Upgrade

Broad Area Maritime Surveillance (BAMS) UAV

(BAMS UAV Represented By Global Hawk Air Vehicle)

- **Persistent maritime/land ISR capability**
  - **Similar in performance to Global Hawk – World Wide Ops**
- **Operates in altitude or stand-off sanctuary**
- **Direct sensor data to CVN through CDL**
- **Carrier Battle Group and Amphibious Readiness Group**

Inverse / Synthetic Aperture Radar

Ground / Maritime / Air Mobile Target Indicator

Electro-Optical / IR Wide Area Search

SIGINT